



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
[www.uspto.gov](http://www.uspto.gov)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/926,188	09/20/2001	Toshihiro Ando	011147	4371
38834	7590	08/06/2004		
WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP 1250 CONNECTICUT AVENUE, NW SUITE 700 WASHINGTON, DC 20036			EXAMINER	SONG, MATTHEW J
			ART UNIT	PAPER NUMBER
			1765	

DATE MAILED: 08/06/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>
	09/926,188 ANDO ET AL. <i>q</i>	
	<b>Examiner</b>	<b>Art Unit</b>
	Matthew J Song	1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) Responsive to communication(s) filed on 24 May 2004.
- 2a) This action is FINAL.                    2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) Claim(s) 1,3,4,6,7 and 20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) Claim(s) \_\_\_\_\_ is/are allowed.
- 6) Claim(s) 1,3,4,6,7 and 20 is/are rejected.
- 7) Claim(s) \_\_\_\_\_ is/are objected to.
- 8) Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on \_\_\_\_\_ is/are: a) accepted or b) objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
 a) All    b) Some \* c) None of:  
 1. Certified copies of the priority documents have been received.  
 2. Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- 1) Notice of References Cited (PTO-892)
- 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
 Paper No(s)/Mail Date \_\_\_\_\_
- 4) Interview Summary (PTO-413)  
 Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) Notice of Informal Patent Application (PTO-152)
- 6) Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 4/23/2004 has been entered.

### ***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 1, 3, 4, 6-7 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Imai et al (US 5,001,452) in view of Imai et al (JP 01-103994), an English Abstract and an English Translation have been provided, along with Jin et al (US 5,977,697).

Imai et al ('452) discloses a method of forming a n-type diamond semiconductor (col 1-8) using a reaction gas composed of  $\text{CH}_4$ ,  $\text{H}_2\text{S}$  and  $\text{H}_2$  to form S-doped diamond films on the (100) face of a single crystal diamond substrate by microwave plasma assisted CVD process (Example 1) with an electron mobility of  $590 \text{ cm}^2/\text{V}\cdot\text{s}$  (Table 1).

Imai et al ('452) does not disclose mechanically polishing a diamond substrate to make it an inclined diamond substrate.

In a method of growing a diamond single crystal free from defects and having a smooth surface by specifying the orientation of the growth face of the substrate, Imai et al (JP '994) teaches a diamond single crystal layer is grown on a diamond single crystal substrate in a vapor phase, where a polished face having less than a  $8^\circ$  angle to the face orientation of (111) or (100) face is used as the growth face of the substrate and by this method a diamond single crystal layer having satisfactory crystallinity and a flat surface can easily be produced (Abstract).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Imai et al ('452) with Imai et al (JP '994) to grow of crystal of diamond free of defects and having a smooth surface.

The combination of Imai et al ('452) and Imai et al (JP '994) does not disclose subjecting a surface of the inclined diamond substrate to a smoothening treatment making it even.

In a method of forming diamond emitters, note entire reference, Jin et al teaches a diamond thin film is loaded into a microwave plasma chamber for surface treatment, this reads

on applicant's smoothening treatment, where the plasma was pure hydrogen and the plasma chamber was operated at a microwave power of 1 kW (1000 W) and a total pressure of 20 Torr, a substrate temperature of 700°C and plasma exposure for 60 minutes. Jin et al also teaches after the treatment process the sample was subjected to a diamond overcoat process in the plasma chamber using methane gas at a substrate temperature of 700°C (col 9, ln 45-67). Jin et al also teaches the hydrogen plasma cleans the diamond surface by removing carbonaceous and oxygen or nitrogen related contaminants and also introduces hydrogen-terminated diamond surface and the plasma also removed any graphite or amorphous carbon phases present on the surface and along the grain boundaries (col 5, ln 15-67).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Imai et al ('571) and Imai et al (JP '994) with Jin et al to clean the surface and remove amorphous phases, thereby improving crystallinity.

Referring to claim 1, the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a similar method of making an n-type semiconductor diamond as applicant. The combination of Imai et al ('571), Imai et al (JP '994) and Jin et al is silent to the n-type semiconductor has a single donor level of 0.38 eV. It is inherent to the n-type diamond taught by the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al to have same because the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a similar method of forming a n-type diamond as applicant.

Referring to claim 3, the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a polished inclined diamond substrate with an angle of less than 8° and smoothening the substrate prior to deposition of a n-type diamond by microwave plasma.

Referring to claim 4, the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a (100) orientated substrate.

Referring to claim 6, the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a pressure of 20 Torr, a microwave output of 1000 W, a temperature of 700°C for a period of 1 hour.

Referring to claim 7, the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a temperature of 700°C.

Referring to claim 20, the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al teaches a temperature of 700°C. Temperature is well known in the art to be a result effective variable, note Tsuno et al (US 5,474,021) below. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Imai et al ('571), Imai et al (JP '994) and Jin et al by optimizing the temperature by conducting routine experimentation of a result effective variable (MPEP 2144.05).

#### ***Response to Arguments***

4. Applicant's arguments filed 4/23/2004 have been fully considered but they are not persuasive.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., the diamond film growth takes place by using the substrate by the step flow growth mechanism (pg 5)) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification,

limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., the roughness can be reduced to only 5 nm (pg 6)) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references (pg 7). See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Jin et al teaches hydrogen plasma treatment of a diamond substrate. The inclined and polished substrate is taught by Imai et al ('452) or Imai et al ('994).

Applicants' argument that the range of 1.5 to 6 degrees is not predictable and therefore unexpected is noted but is not found persuasive. JP '994 teaches a tilting within 8 degrees of zero, which overlaps the claimed range. Overlapping ranges are held to be obvious (MPEP 2144.05).

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). JP '994 teaches tilted and polished substrate. The hydrogen plasma treatment step is taught by Jin et al. Applicants'

allegation of unexpected results is not persuasive because there is no comparison with the hydrogen plasma treatment of Jin et al, merely a comparison of the process of Imai et al, which the Examiner admitted does not use a hydrogen plasma treatment. There is no comparison of the combination of Imai et al ('571), Imai et al ('994) and Jin et al.

Applicants' argument that the combination of Imai et al ('571), Imai et al ('994) and Jin et al does not teach a single donor level of 0.38 eV is noted but is not found persuasive.

Applicants allege that the cited references do not teach the donor level and the donor level is largely different than the theoretical value because a person of ordinary skill would have disclosed the donor value. This argument is viewed as mere attorney argument, which lacks evidence; therefore is not found persuasive. The Examiner admitted in the rejection that the cited references are silent to the donor level. However, the Examiner maintains that the combined teachings of Imai et al ('571), Imai et al ('994) and Jin et al inherently would produce a doped semiconductor with a similar donor level because the method of producing the n-type diamond semiconductor used by applicants to obtain a diamond with a donor level of 0.38 eV is taught by the combination of Imai et al ('571), Imai et al ('994) and Jin et al. A similar method of producing a product is expected to result in a product with similar properties.

Applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references. Applicants' "believe" (pg 10) that the donor level of 0.38 eV has not been realized previously is not persuasive. The fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the

Art Unit: 1765

differences would otherwise be obvious. The sole difference between the teaching of the prior art and the instantly claimed invention is the single donor level of 0.38 eV. The prior art teaches a similar method of manufacturing n-type diamond, used by applicants manufacture the n-type diamond with a 0.38 eV donor level. A similar method of manufacturing diamond will inherently produce a diamond with similar properties; therefore the difference would have naturally flowed from the teachings of the prior art.

***Conclusion***

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Tsuno et al (US 5,474,021) teaches the temperature and growth plane of a substrate are result effective variable for the growth of diamond single crystal by microwave plasma CVD (Example 1).

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 1765

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Matthew J Song  
Examiner  
Art Unit 1765

MJS

NADINE G. NORTON  
SUPERVISORY PATENT EXAMINER  
